Phase 1 - Optimal Neutron Source & Beam Shaping Assembly For Boron Neutron Capture Therapy

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The primary objective of Phase 1 of this project was the development of 2-D SWAN -- a first-of-its-kind general purpose two-dimensional code for the optimization of source-driven systems (such as facilities for medical applications, radiation shields, and blankets of accelerator-driven systems and of fusion facilities). This objective has been accomplished.

The accuracy of 2-D SWAN was checked by comparing the Effectiveness Functions (EFs) it generates against those of the well tested SWAN (1-D). This comparison was done for 1-D systems that were modeled by the 2-D SWAN as 2-D systems having reflective boundary conditions in the transverse direction (not accounted for by the 1-D SWAN). Thus, the problems used for benchmarking could be accurately modeled by both the 2-D and the reference 1-D SWAN. The 2-D SWAN was found to generate accurate EFs.

The development of a capability to make 2-D plots of EFs is close to completion.

We started to study the efficiently of the 2-D optimization process. We are focusing on unconstrained problems considering performance parameters of two types: linear flux functionals (as the dose rate behind a shield), and the ratio of linear flux functionals. (the H/L ratio of equivalent-dose to tumor to equivalent-dose to normal tissue for BNCT applications).

A User Manual will be prepared later this year. It will include a number of sample problems illustrating how to use the 2-D SWAN to (1) select promising constituents; and optimize systems to minimize or maximize performance parameters of the form of (2) reaction rate, and (3) ratio of reaction rates.

In summary, the primary objective of Phase 1 has been achieved – the development of a 2-D general purpose two-dimensional code for the optimization of source-driven systems. This is the first code of its kind and is expected to find many useful applications in the research, development, design and analysis of a variety of nuclear systems.